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(71) Applicant: HEUFT-QUALIPLUS B.V.  
Arnhemstraat 34 012  
NL-7418 CL Deventer(NL)

(72) Inventor: Morskloft, Maria Gertrudis  
Vöckerweg 18  
NL-7554 RK Hengelo(NL)

(74) Representative: Schumann, Bernard Herman  
Johan et al  
OCTROOIBUREAU ARNOLD & SIEDSMA  
Sweelinckplein 1  
NL-2517 GK The Hague(NL)

(54) A method and an apparatus for detecting cracks in the mouth zone of a transparent container.

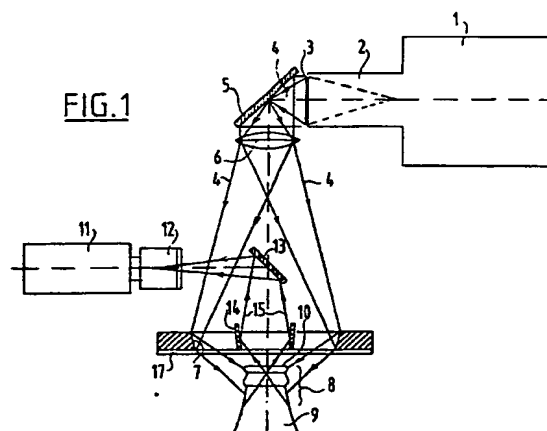
(57) The invention provides a method and apparatus for detecting cracks, if any, in the mouth zone of a transparent container, e.g. a glass bottle.

Such apparatus comprises:

means for positioning a transparent container (9) in a desired position;

illuminating means (1),(2),(5),(6),(7) for illuminating the outer surface of the mouth zone (8) to be inspected;

sensing means (11),(12),(13),(14) for sensing the image of the inner surface of said mouth zone, said illuminating means being designed such that in case of a good container the sensing means do not sense reflected light.



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## A method and an apparatus for detecting cracks in the mouth zone of a transparent container

It is desired to be able to automatically detect the presence of cracks in the mouth zone of a transparent container.

I view thereof the invention provides a method for detecting cracks, if any, in the mouth zone of a transparent container, e.g. a glass bottle, said method comprising the steps of:

- (1) providing a transparent container;
- (2) illuminating the outer surface of the mouth zone to be inspected;
- (3) sensing the image of the inner surface of said mouth zone; and
- (4) carrying out step (2) in such a way that in case of a good container the surface of the mouth zone does not give a detectable reflection at step (3).

Also the invention relates to an apparatus adapted thereto. Such apparatus comprises

- (1) means for positioning a transparent container in a desired position;
- (2) illuminating means for illuminating the outer surface of the mouth zone to be inspected;
- (3) sensing means for sensing the image of the inner surface of said mouth zone, said illuminating means being designed such that in case of a good container the sensing means do not sense reflected light.

Very practical is that embodiment, in which the light source and the mouth zone are substantially similarly shaped.

In order to achieve an optimum use of the resolution of a detecting system that embodiment is preferred, in which the sensing means comprise a conical mirror positioned such that the inner surface can be inspected with an increased opening angle.

The invention will now be explained with reference to the accompanying drawing. In the drawing:

Figure 1 is a schematic view of an arrangement according to the invention; and

Figure 2 is a detail on an enlarged scale of the arrangement according to figure 1 for explaining the inspection according to the invention.

Figure 1 shows a light source 1, in this case a stroboscopic light source, to which a conical light conductor 2 is added, the front edge 3 of which is a secondary annular light source. Such an arrangement is described in Dutch patent application 8800866, not published before, in the name of Thomassen & Drijver-Verblifa N.V., a firm of which the present applicants have recently divided off.

The light 4 emitted by the annular light source is reflected by a flat mirror 5 and via a lense 6 directed to a conical mirror 7 illuminating in the

way shown the mouth zone 8 of a glass bottle 9. It will be clear that the upper edge 10 of the bottle is not illuminated. This is important in view of the inspection to be described hereinafter.

- 5 A video-camera 11 with an objective lens 12 senses via a flat mirror 13 and a conical mirror 14 the inner wall of the mouth zone 8 of the bottle 9. As a result of the presence of the conical mirror an effective image magnification takes place, resulting in a more detailed video-image and a better use of the resolution.

- 10 In case of a perfect mouth zone, i.e. a not-cracked mouth zone, no reflection in the direction of the video-camera takes place. In that case the picture is dark. If, however, as is shown in figure 2, in the mouth zone 8 a crack 16 is present, this crack will reflect the impinging light, which reflected light, referred to with 15, reaches via conical mirror 14 camera 11 for forming a picture there.

- 20 It should be noted that the drawing is not exactly drawn in scale.

- For safeguarding the optical parts of the inspection system against external influences the optical parts are enclosed by a closed housing. The upper side of a container to be inspected is sensed and illuminated through a glass plate 17, which also serves for supporting the conical mirror 7 and the conical mirror 14. By means of a support not-shown, the glass plate 17 also carries the flat mirror 13.

- 30 It should be noted that the conical mirrors can also exhibit curved shapes, by means of which a desired magnification or reduction may be realized.

### Claims

1. A method for detecting cracks, if any, in the mouth zone of a transparent container, e.g. a glass bottle, said method comprising the steps of:
  - (1) providing a transparent container;
  - (2) illuminating the outer surface of the mouth zone to be inspected;
  - (3) sensing the image of the inner surface of said mouth zone; and
  - (4) carrying out step (2) in such a way that in case of a good container the surface of the mouth zone does not give a detectable reflection at step (3).
2. An apparatus for carrying out the method according to claim 1 for detecting cracks in the mouth zone of a transparent container, e.g. a glass bottle, said apparatus comprising:
  - (1) means for positioning a transparent container in a desired position;

(2) illuminating means for illuminating the outer surface of the mouth zone to be inspected;

(3) sensing means for sensing the image of the inner surface of said mouth zone, said illuminating means being designed such that in case of a good container the sensing means do not sense reflected light.

3. The apparatus according to claim 2, characterized in that the light source and the mouth zone are substantially similarly shaped.

4. The apparatus according to claims 2 or 3, characterized in that the sensing means comprise a conical mirror positioned such that the inner surface can be inspected with an increased opening angle.

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FIG.1

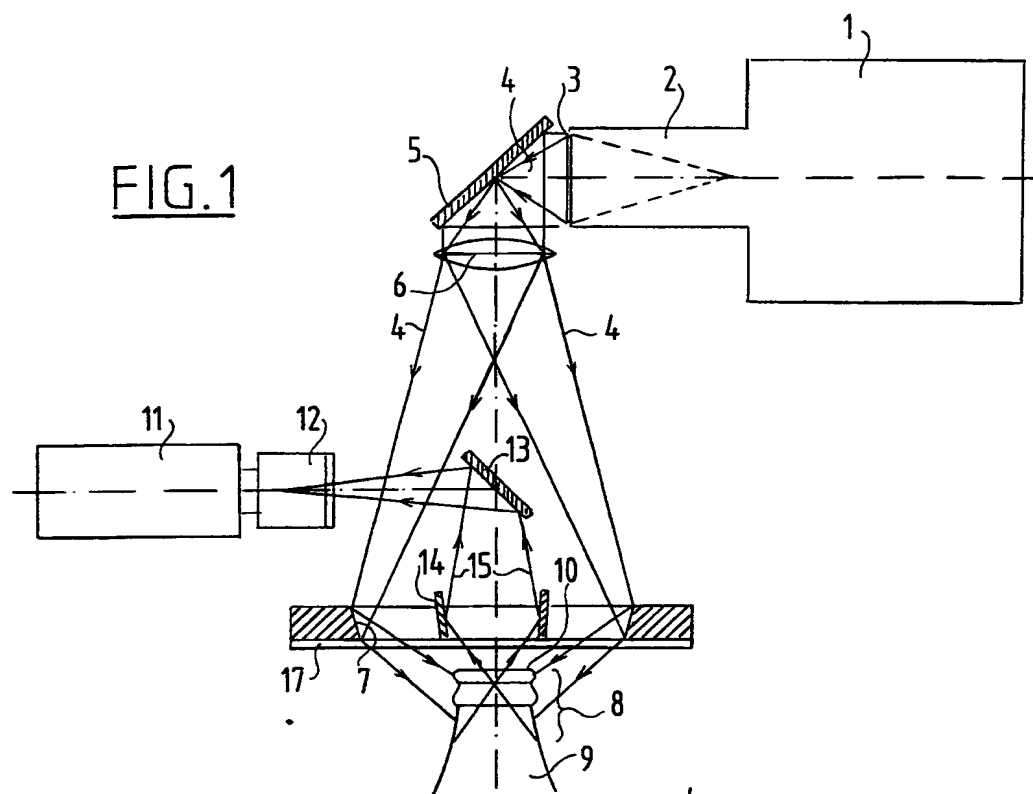
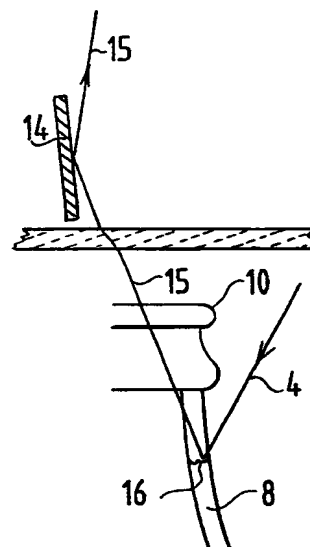


FIG.2





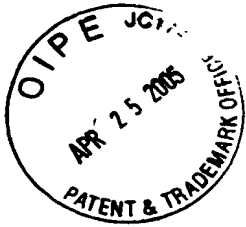
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# EUROPEAN SEARCH REPORT

Application Number

EP 89 20 2956

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-3 735 144 (M. BABUNOVIC) * Claim 1; column 2, lines 57-61; column 4, lines 44-48 *	1,2	G 01 N 21/90
X	US-A-4 424 441 (J. BIERINGER et al.) * Claims 1,4; figures 1-3 *	1,2	
X	GB-A-2 159 617 (HAJIME INDUSTRIES) * Claim 1; figure 5A *	1,2	
X	DE-A-2 718 802 (PONHDORF HANDELSGESELLSCHAFT K.G.) * Claims 1,5; pages 7,8; figure *	1,2	
X	PATENT ABSTRACTS OF JAPAN, vol. 5, no. 202 (P-95)(874), 22nd December 1981; & JP-A-56 126 706 (MITSUBISHI DENKI K.K.) 05-10-1981 * Abstract; figure *	1,2	
A	EP-A-0 209 077 (KIRIN BEER K.K.) * Claims 1-6 *	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	US-A-3 453 054 (W. PHILLIPS) * Claims 1-4 *	1,2	G 01 N
A	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 157 (P-464)[2213], 6th June 1986; & JP-A-61 10 748 (ASAHI BIIRU K.K.) 28-01-1986 -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22-02-1990	Examiner VAN DEN BULCKE E.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



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